CHAPTER 6

CARE AND ADJUSTMENT OF SURVEYING EQUIPMENT

To a great extent, the accuracy and quality of your surveys will depend upon how well you take care of your surveying equipment; therefore, the first part of this chapter reviews the proper instrument handling, stowing, and maintenance practices that you studied in the EA3 TRAMAN. While to some readers this review may seem redundant, taking care of your equipment properly cannot be overemphasized.

In this chapter we also discuss instrument adjustment and repair. As used in this chapter, the term ***adjustment*** means bringing the various fixed parts of an instrument into proper relationship with one another. It is different from the ordinary operations of leveling the instrument, aligning the telescope, and so forth.

CARE OF INSTRUMENTS

As you know, every instrument is accompanied by a user's manual that tells you not only the proper operation and components of the instrument but also its proper care and maintenance. Study this user's manual thoroughly before you even attempt to use the instrument. Some suggestions for the care and maintenance of surveying equipment are discussed in the following paragraphs.

HANDLING, CARRYING, AND STOWING

Always exercise care in handling instruments, such as the transit, level, theodolite, or plane table. When removing an instrument from its carrying case, NEVER grasp the telescope. Wrenching the telescope in this manner could damage a number of delicate parts. When you set up an instrument, make sure that it is securely fastened to the tripod head. In tightening the various clamp screws, leveling screws, and adjustment screws, bring them only to a firm bearing. Overtightening these screws may strip the threads, twist off the screw, bend the connecting part, or place undue stresses in the instrument. NEVER leave an instrument unattended while it is set upon a street, near construction work or in any other place where it can be damaged.

When you carry an instrument mounted on a tripod, place the instrument and tripod on one shoulder with the tripod legs pointing forward and held together by your hand and forearm. If you are walking along a sidehill, you should always carry the instrument on the downhill shoulder. This leaves the uphill arm and hand free to catch yourself should you trip or stumble. Before climbing over a fence, you should first place the instrument on the other side with the tripod legs well spread. Also, when carrying an instrument, you should ensure that all clamp screws are only lightly clamped so that the parts will move if the instrument is struck. Avoid carrying the instrument on your shoulder through doorways or beneath low-hanging branches; instead, you should carry it under your arm with the head of the instrument to the front.

Every transit, theodolite, or level comes equipped with a carrying box or case. The instrument and its accessories can be stowed in the case in a manner that ensures a minimum of motion during transportation. The instrument should ALWAYS be stowed in the carrying case when it is not in use.

Bags are provided for carrying stakes and hubs. These are usually canvas bags equipped with a shoulder strap and closely resemble a newsboy's bag. A newsboy's bag, in fact, makes an excellent carrying bag for stakes and hubs. So does a Navy seabag, equipped with a shoulder strap.

Various types of leather or canvas bags and sheaths, such as chaining-pin quivers, plumb-bob sheaths, and sheaths for Abney and Locke levels, are provided for various items of equipment. Most of these can be attached to the belt. Leather pouches, also usually attachable to the belt, are available for carrying small tools, marking equipment, turning-point pins, and the like. In time you will learn various conveniences, such as carrying your supply of surveyor's tacks stuck in a rubber ball or in a piece of softwood attached to your belt.

CLEANING AND LUBRICATION

All surveying instruments, equipment, or tools must be thoroughly cleaned immediately after you have used them; for example, after each use, you must dust off the transit or theodolite and wipe it dry before placing it back in its case. Remove all dust with a soft brush before wiping dirty components with a clean cloth. When the

instrument becomes wet, you should remove it from its carrying case and dry it thoroughly at room temperature once you get home. NEVER leave a wet instrument stored in the carrying case.

NEVER rub the lenses of a telescope with your fingers or with a rough cloth. Clean chamois leather or a lint-free soft cloth is suitable for this purpose. Occasionally, you may clean the lenses with a soft cloth that is dampened with a mixture of equal parts of water and alcohol.

You should always remove mud and dirt from tripods, range poles, leveling rods, and so forth, immediately after each use. This is very important, especially when the surveying gear is made of a material that is susceptible to rust action or decay.

When lubricating instruments, you must use the right lubricant that is recommended for the climatic condition in your area; for instance, it is recommended that graphite be used to lubricate the moving parts of a transit when the transit is to be used in sub-zero temperatures; however, in warmer climates you should use alight film of oil (preferably watch oil).

Consult the manufacturer's manual or your senior EA whenever you are in doubt before doing anything to an instrument.

INSTRUMENT ADJUSTMENTS AND REPAIRS

Making minor adjustments and minor repairs to surveying instruments are among the responsibilities of EA personnel. Minor adjustments and minor repairs are those that can generally be done in the field using simple tools. Major adjustments and major repairs are those generally done in the factory. If the defect in the instrument cannot be corrected by minor adjustment or minor repair, do not attempt to disassemble it; instead, make necessary arrangements for sending the instrument to the manufacturer. Most surveying instruments are precision instruments for which major adjustments and recalibration require special skills and tools that can be provided only by the instrument company or its subsidiaries.

INSTRUMENT ADJUSTMENTS

As stated previously, adjustment, as used in this chapter, means the process of bringing the various parts of an instrument into proper relationship with one another. The ability to make these adjustments is an important qualification of any surveyor. To make proper adjustments, the surveyor should have the following knowledge:

1. They must be familiar with the principles upon which the adjustments are based.

2. they must know the methods or tests used to determine if an instrument is out of adjustment.

3. They must know the procedure for making adjustments and the correct sequence by which adjustments must be made.

4. They must be able to tell what effect the adjustment of one part will have on other parts of the instrument.

5. They must understand the effect of each adjustment upon the instrument when it is actually used for measurement.

Generally, instrument adjustments involve the level tubes, the telescope, and the reticle; for example, if one or both of the plate-level bubbles of an engineer's transit are centered when the plate is, in fact, not level, the instrument is out of adjustment. An optical instrument equipped with vertical and horizontal cross hairs is out of adjustment if the point of intersection between the cross hairs does not coincide with the optical axis. If the reflected bubble on a Locke or Abney level is centered when the optical axis is other than horizontal, the instrument is out of adjustment.

The process of adjustment chiefly involves the steps that are necessary to bring a bubble to center when it should be at center or to bring a cross-hair point of intersection into coincidence with the optical axis. Instrument manufacturers publish handbooks containing recommended adjustment procedures. These are usually small pamphlets, obtainable free of charge.

The following discussion is intended to give you an idea of general instrument adjustment procedures. For adjusting your particular instruments, however, you should follow the appropriate manufacturer's instructions.

General Adjustment Procedures

Instruments should be carefully checked periodically to determine whether or not they need adjustment. There is an adage that an instrument should be checked frequently but adjusted rarely. The basis for this adage is the fact that modern quality instruments get out of adjustment much less frequently than is generally believed; consequently, a need for adjustment is frequently caused by a previous improper adjustment that was not really required but resulted from errors in checking.

Before assuming that adjustment is necessary, you must positively ascertain that an apparent maladjustment actually exists. The following procedures apply, in general, to all tripod-mounted optical instruments that you may use in surveying:

1. Check the instrument on a cloudy day, if possible.

2. Ascertain that the tripod shoes are tight and that the instrument is screwed all the way down on the tripod.

3. Set the tripod up on firm ground in the shade, but in a good light, where a sight of at least 200 feet can be taken in opposite directions.

4. Spread the tripod feet well apart and place them so that the plate is approximatel y level. Press the shoes in firmly, or set them in cracks or chipped depressions if on a hardened surface. (Avoid setting up on asphalt pavement in warm weather.)

5. After the tripod feet are set, release and then retighten the wing nuts. The purpose of this is to release any possible residual friction that, if not released, might cause an eventual shift in the legs.

6. Level the instrument with particular care. After leveling, loosen all level screws slightly (again to release residual friction) and relevel. Tighten all screws with equal firmness but avoid overtightening. Too much tightness will eventually deform the centers, causing both friction and play.

7. Carry out all checks in the order prescribed for the instrument. Do NOT make an adjustment unless the same check, repeated at least three times, indicates the same amount of error every time.

8. Remember that most tests show an error that is **double** the actual displacement error in the instrument.

Be especially watchful for **creep;** that is, a change in position caused by settlement or by temperature change in the instrument. To detect any possible creep, you should allow every set bubble or setline of sight to stand for a few seconds and ensure that no movement occurs during the interval.

Before an adjustment is made, consider whether or not the error discovered will have a material effect on field results. Make adjustments in a prescribed order. After making an adjustment, retighten the adjusting parts firmly but not too tightly. Then repeat the original check and readjust if necessary. After making all the contemplated adjustments, repeat the entire round of checks in the prescribed order. This will indicate whether or not an adjustment has been disturbed by a subsequent adjustment.

In the following sections, we will discuss the field tests and adjustments that you need to know how to perform for the engineer's level and the transit. While the principles of performing the adjustments are nearly the same for one manufacturer's level or transit as compared to those produced by another manufacturer, there are some differences in detail. For this reason, when preparing to perform an adjustment to an instrument, you should first consult the operator's manual for that instrument.

When a high degree of accuracy is required for surveying results, the level or transit used must be in perfect adjustment. In this event, you must perform the tests described in the following sections and make any necessary adjustments to the instrument. When results of lower accuracy can be tolerated, however, you can usually compensate for the maladjustment of a part until a proper adjustment can be made. Therefore, at the end of each of the following instrument-adjustment discussions, a method of compensating for the maladjustment is noted. You should keep in mind, however, that if you frequently check your instruments and keep them in good adjustment, these compensations should seldom be necessary.

Engineer's Level Adjustments

Regardless of how well an engineer's level is manufactured, you should perform certain checks and field adjustment at regular intervals; for example, you should test the instrument every day before starting work. You also should check it for proper adjustment anytime the level is bumped or jolted. The parts of the level that you will check are the level tube and the cress hairs. For the latter, be sure that parallax is removed and that the cross hairs and objective are sharply focused. To do this, use a well-defined object at least 250 feet away. When parallax is present, the image is not exactly in the plane of the cross hairs, and the objective focusing must be refined. Since this condition can occur each time the objective lens is focused, you must make a parallax check each time you observe a new object.

When adjusting the engineer's level, it is important that you accomplish the tests and adjustments in a prescribed sequence. The reason for this is that one adjustment may depend upon, or alter, another adjustment. The following paragraphs describe, in proper sequence, the test and adjustment procedures that you should follow when checking and adjusting the engineer's level.

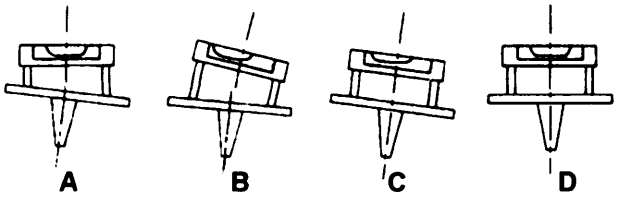

Figure 6-1.—Adjusting the level tube.

ADJUSTING THE LEVEL TUBE.— The vertical axis of rotation of the instrument is the basis for all adjustments to the engineer's level. When the instrument is set up and leveled the vertical axis of rotation and the longitudinal axis of the level tube should be perpendicular to one another. If they are not perpendicular, then the vertical axis cannot be made truly vertical. Adjustment of the level tube makes the axis of the level tube perpendicular to the vertical axis. To check and adjust the level tube, you should follow the procedures below:

1. Setup the instrument and approximately level the bubble over each pair of opposite leveling screws. Then carefully center the bubble over one pair of screws, as shown in view A, figure 6-1.

2. Rotate the instrument 180°. If the bubble remains centered, then the level tube is in proper adjustment. If the bubble does NOT remain centered note the movement of the bubble away from center (view B, fig. 6-1).

3. Bring the bubble half the distance back to the center of the tube by turning the capstan nuts at one end of the tube (view C, fig. 6-1).

4. Relevel with the leveling screws (view D, fig. 6-1) and rotate the instrument again. Repeat Step 3 above if the bubble does not remain at the center of the tube.

5. Check the final adjustment by noting that the bubble remains in the center of the tube during the entire revolution about the vertical axis.

NOTE: When the level tube is out of adjustment, you can compensate for it by releveling the instrument before each sighting.

ADJUSTING THE HORIZONTAL CROSS HAIR.— For the horizontal cross hair to lie in a truly horizontal plane when the instrument is leveled, the horizontal cross hair must be perpendicular to the vertical axis. To make the horizontal cross hair (fig. 6-2) lie in a plane perpendicular to the vertical axis, you should perform the following steps:

1. With the instrument carefully leveled, sight one end of the horizontal cross hair on a well-defined point at least 250 feet away. Turn the telescope slowly about the vertical axis, using the slow motion screw. If the cross hairs are in adjustment, the horizontal cross hair will stay on the point through its entire length.

2. If it does not stay on the point, loosen two adjacent reticle capstan screws and rotate the reticle by lightly tapping two opposite screws.

3. Sight on the point again. If the horizontal cross hair does not stay on the point through its entire length, rotate the ring again.

4. Repeat this process until the condition is satisfied.

NOTE: To compensate for the above maladjustment, you should use only that part of the horizontal cross hair that is closest to the vertical hair for all sightings.

ADJUSTING THE LINE OF SIGHT.— For a perfectly adjusted level, the line of sight is parallel to the axis of the level tube. When the level meets this condition, the line of sight will generate a truly horizontal plane when the instrument is rotated. When

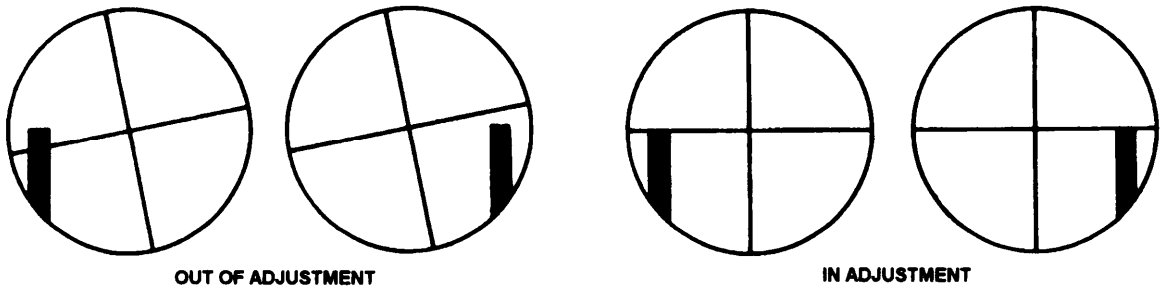

Figure 6-2.—Adjusting the horizontal cross hair.

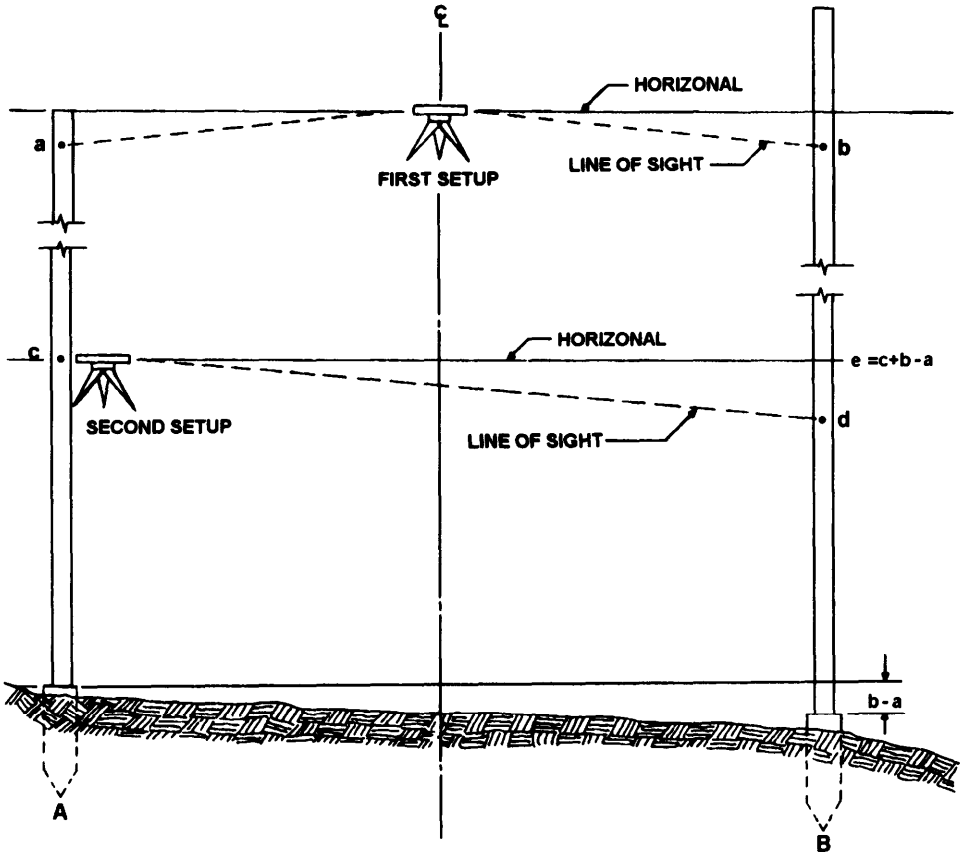

Figure 6-3.—Two-peg test method.

the line of sight is not parallel to the axis of the level tube, then you must adjust the line of sight. The method used for adjustment is known as the *two-peg test* (fig. 6-3). This method requires you to do the following steps:

1. Setup and level the instrument (first setup, fig. 6-3). Drive stake (peg) A about 150 feet away, then drive stake *B* at the same distance in the opposite direction.

2. Take a rod reading a on stake *A* and a rod reading *b* on stake *B*. With the instrument exactly halfway between the two stakes, *b-a* is the true difference in elevation between the stakes.

3. Move the instrument close to stake *A* (second setup, fig. 6-3) so that the eyepiece is within a half inch from the rod. Then, by sighting through the objective-lens end of the telescope, take a rod reading c on stake *A*. Next, take a rod reading *d* on stake *B* in the normal manner. If the instrument is in adjustment, *d-c* will equal *b-a*.

4. If the instrument is out of adjustment, calculate what the correct rod reading e should be on the farther rod *B* ($e = c + b - a$). Set the rod reading *e* with a target for accurate reading. Move the horizontal cross hair to the correct reading (on target) by loosening the correct vertical screw and tightening the opposite screw.

5. Check the horizontal cross hair adjustment again. The ring may have rotated during this adjustment.

6. Rerun the peg test to check the adjustment.

NOTE: The compensation for the above maladjustment is careful balancing of your backlights and foresights.

Transit Adjustments

You must be capable of performing six commonly performed tests and adjustments of the transit. All tests and adjustments of the transit are made with the instrument mounted on its tripod and setup in the shade. You must make these tests periodically and in the sequence in which they are discussed in the following paragraphs. When one of the tests indicates that an adjustment is necessary, you must make this adjustment and then you must repeat all previous tests before proceeding with the next test.

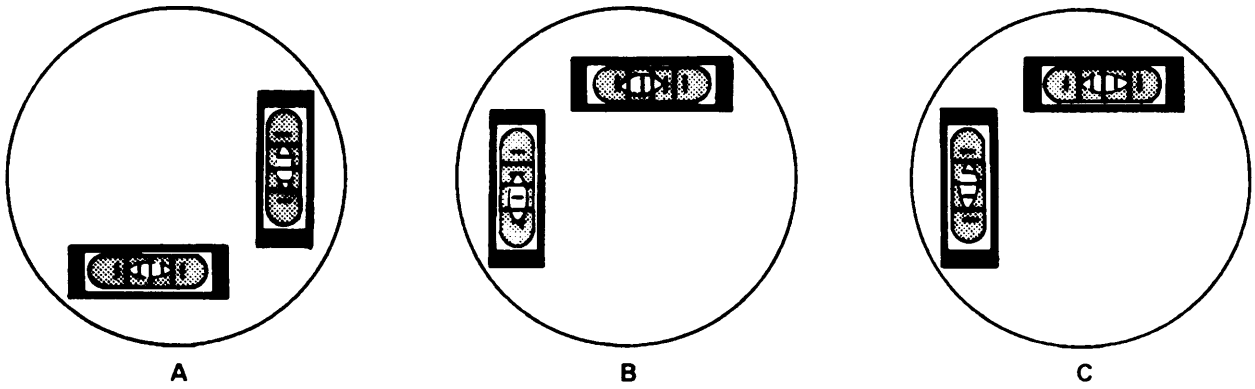

Figure 6-4.—Adjusting the plate bubbles.

ADJUSTING THE PLATE BUBBLES.— The purpose of adjusting the plate bubbles is to make the axis of the plate-level tubes perpendicular to the vertical axis (fig. 6-4). This ensures that when the instrument is set up and leveled, the vertical axis is truly vertical. When this condition is met, horizontal angles are measured in a truly horizontal plane and vertical angle do not incur index error because of an inclined vertical axis.

You should make the plate-bubble test every time you set up the instrument for use and always before making any other tests and adjustments of the transit. Make this test and adjustment using the following steps:

1. Rotate the instrument about the vertical axis and bring each level tube parallel to a set of opposite leveling screws. Bring both bubbles to the center of their tubes by turning the leveling screws (view A, fig. 6-4).

2. Rotate the instrument 180° about its vertical axis. If the bubbles remain centered, no adjustment is necessary. If the bubbles do not remain centered, note the amount of distance that the bubbles move from their center (view B, fig. 6-4) and proceed with Steps 3 through 5.

3. Bring each bubble half the distance back to the center of its tube by turning the capstan screws at the end of each tube.

4. Relevel the instrument using the leveling screws and rotate the instrument again. Make a similar correction if the bubbles do not remain in the center of the tubes.

5. Check the final adjustment by noting that the bubbles remain in the center of the tubes during the entire revolution about the vertical axis (view C, fig. 6-4).

NOTE: You can compensate for out-of-adjustment plate levels by leveling the instrument, rotating it 180° in azimuth, and bringing the bubbles halfway back using the leveling screws.

ADJUSTING THE VERTICAL CROSS HAIR.— In a perfectly adjusted transit, the vertical cross hair should lie in a plane that is perpendicular to the horizontal axis. In this way, any point on the hair may be used when measuring horizontal angles or running lines.

To make the vertical cross hair lie in a plane perpendicular to the horizontal axis (fig. 6-5), you should follow the procedure below:

1. See that parallax is eliminated. Sight the vertical cross hair on a well-defined point; and with all motions clamped, move the telescope slightly up and down on its horizontal axis, using the vertical slow motion tangent screw. If the instrument is in adjustment, the vertical hair will appear to stay on the point through its entire length.

2. If it does not stay on the point, loosen the two capstan screws holding the cross hairs and slightly rotate the ring by tapping the screws lightly.

3. Sight again on the point. If the vertical cross hair does not stay on the point through its entire length as the telescope is moved up and down, rotate the ring again.

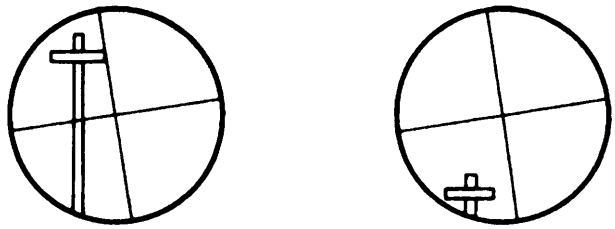

Figure 6-5.—Adjusting the vertical cross hair.

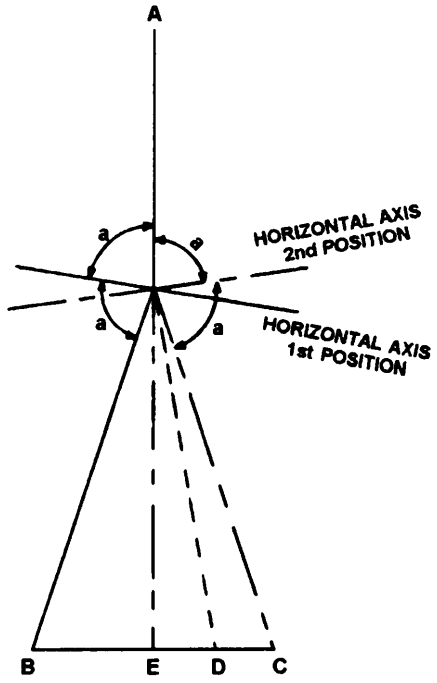

Figure 6-6.—Adjusting the line of sight.

4. Repeat this process until the condition is connected.

NOTE: To compensate for the above maladjustment, use only that part of the vertical hair that is closest to the horizontal cross hair.

ADJUSTING THE LINE OF SIGHT.— In a perfectly adjusted telescope, the line of sight should be perpendicular to the horizontal axis at its intersection with the vertical axis. To make the line of sight perpendicular to the horizontal axis (fig. 6-6), you should proceed as follows:

1. Sight on a point, A, at a distance of not less than 200 feet with the telescope normal; clamp both plates.

2. Plunge the telescope and set another point, *B,* on the ground at a distance from the instrument equal to the first distance and at about the same elevation as point A.

3. Unclamp the upper motion, rotate the instrument about its vertical axis, sight on the first point (telescope inverted), and clamp the upper motion.

4. Plunge the telescope and observe the second point. If the instrument is in adjustment, the point over which it is set will be on a straight line, *AE,* and point *B* will fall at position *E.* If the instrument is not in adjustment, the intersection of the cross hairs (point *C)* will fall to one side of the second point, *B.*

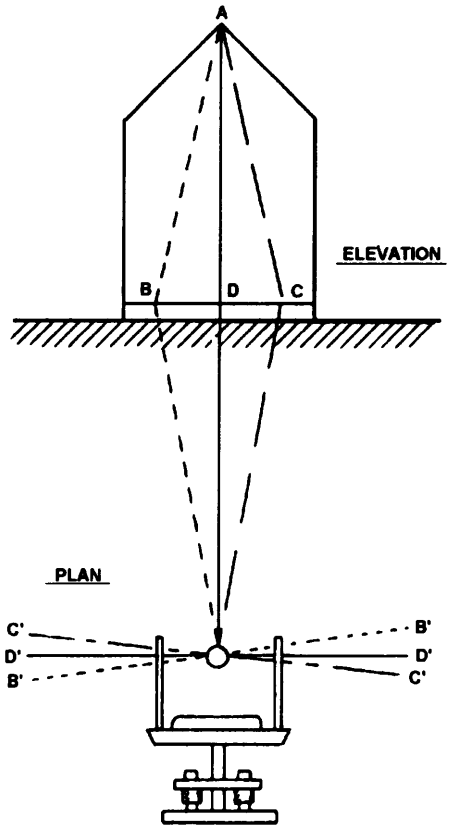

Figure 6-7.—Adjusting the horizontal axis.

5. Measure the distance *BC* and place a point, *D,* one fourth of this distance back toward the original point, *B.*

6. Move the cross-hair reticle horizontally by loosening the screws on one side of the telescope tube and tightening the opposite screw until the vertical cross hair appears to have moved from *C* to the corrected position, *D.*

7. Repeat this operation from number 1 above, until no error is observed.

8. Repeat the test described for adjusting the vertical cross hair, since the vertical cross hair may have rotated during this adjustment.

NOTE: You can compensate for the above maladjustment by double centering (discussed in the EA3 TRAMAN).

ADJUSTING THE HORIZONTAL AXIS.— When you plunge the telescope, the line of sight should generate a truly vertical plane. For this to occur, the horizontal axis of the telescope must be perpendicular to the vertical axis. To make the horizontal axis of the telescope perpendicular to the vertical axis (fig. 6-7), you should perform the following steps:

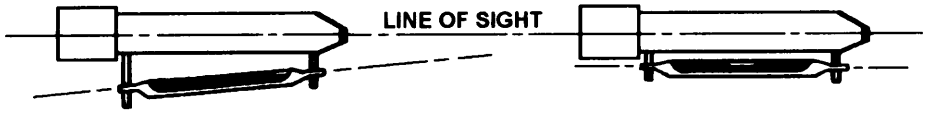

Figure 6-8.—Adjusting the telescope level.

1. Sight the vertical cross hair on some high point, *A,* at least 30° above the horizontal and at a distance of 200 feet, such as the tip of a church steeple or other well-defined object, and clamp the plates.

2. Depress the telescope and mark a second point, *B,* at about the same level as the telescope.

3. Plunge the telescope, unclamp the lower plate, and rotate the instrument about its vertical axis.

4. Sight on the first point, A.

5. Clamp the lower plate and depress the telescope. If the vertical cross hair intersects the second or lower point, *B,* the horizontal axis is in adjustment. In this case, point *B* is coincident with point *D* in both direct and reverse positions of the telescope.

6. If not, mark the new point, *C,* on this line and note the distance, *BC,* between this point and the original point.

7. Mark point *D* exactly midway of the distance *BC. CD* is the amount of correction to be made.

8. Adjust the horizontal axis by turning the small capstan screw in the adjustable bearing at one end of the horizontal axis until point *C* appears to have moved to point *D.*

9. Repeat this test until the vertical cross hair passes through the high and low points in the direct and inverted position of the telescope.

10. Check all previous adjustments.

NOTE: When you cannot immediately correct the above condition, you can compensate by repeating any survey procedure with the telescope reversed and then use the average of the results.

ADJUSTING THE TELESCOPE LEVEL.— To be able to use a transit for direct leveling and to measure vertical angles without index error, you must ensure that the axis of the telescope level is parallel to the line of sight. To adjust the telescope level of the transit, use the same two-peg method that we discussed previously for the engineer's level. The only difference is that you must level the telescope carefully before each reading. After computing the reading that should be made on the far rod (fig. 6-3), you set the horizontal cross hair on the computed reading using the vertical slow motion screw. Then you move one end of the spirit level vertically by means of the adjusting nuts until the bubble is centered in the tube (fig. 6-8).

NOTE: As with the engineer's level, you should compensate for the above maladjustment by careful balancing of all backlights and foresights.

ADJUSTING THE VERTICAL CIRCLE VERNIER.— For vertical angles to be measured without index error caused by displacement of the vertical circle vernier, the vernier should read zero when the plate bubbles and telescope bubbles are properly leveled. To make the vertical circle vernier read zero when the instrument is leveled (fig. 6-9), you should perform the following steps:

1. With the plate bubbles leveled, bring the telescope bubble to the center of the tube and read the vernier of the vertical circle.

2. If the vernier does not read zero, loosen the capstan screws holding the vernier and move the index until it reads zero on the vertical circle.

3. lighten the screws and read the vernier with all the bubbles in the center of their tubes to make sure that

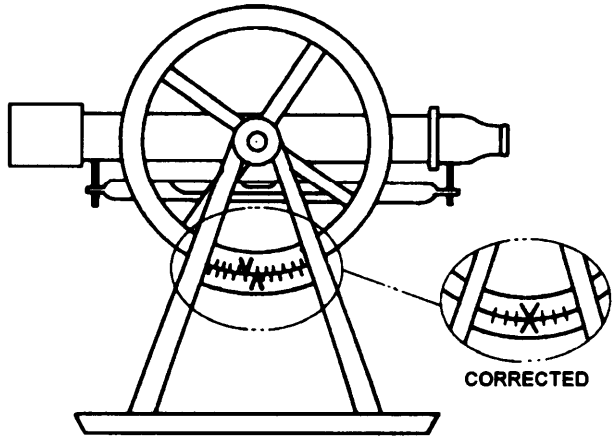

Figure 6-9.—Adjusting the vertical circle vernier.

the vernier still reads zero and has not moved during the operation.

NOTE: To compensate for the above maladjustment, you should read all vertical angles direct and reversed; then use the average of the result.

This concludes our discussion of instrument adjustment. As a reminder, you should always check your surveying instruments frequently for proper adjustment and then make those adjustments either immediately or as soon as practicable. Do not put it off or you may quickly forget to do it until it is too late. Also, be sure to check the manufacturer's instructions before making the adjustments described above or when you need to adjust other instruments, such as the automatic level, alidade, or hand level.

MINOR REPAIRS AND REPLACEMENT PROCEDURES

As stated earlier in this chapter, minor repairs to surveying instruments and equipment are those that can be done in the field with the use of simple tools. Major repairs are done by instrument specialists who are generally employed by the manufacturers of the instruments. You should never attempt to make a major repair yourself.

Repair It or Replace It?

Whether or not you or someone else in the battalion should attempt the repair of a damaged item of equipment depends on the nature of the damage and the character of the item. A broken tape, for example, can easily be spliced (explained in the EA3 TRAMAN). On the other hand, whether or not you should attempt to straighten a bent compass needle depends on the type of compass —for an ordinary pocket compass, perhaps yes; for the compass on a transit, perhaps no. Many types of damage to such articles as range poles, tripod legs, and the like may be repaired in the battalion or PWD shops. Minor damage to instruments maybe repaired occasionally in the battalion machine shop. However, major repairs to instruments, when they are economically worthwhile at all, should be done by manufacturers or their authorized representatives or by competent Navy instrument repairmen.

When in the judgment of the senior EA or the engineering of!icer concerned an instrument is beyond economical repair, it must be surveyed (properly disposed of) by standard survey procedures. Then a replacement instrument must be ordered fkom the Navy supply system. Expendable items are procured in the same manner.

Navy Supply System

Each individual item of equipment or supply that is available through the Navy supply system is identified by a stock number and listed and described in a stock catalog. Identification of the items that may be drawn from supply by a battalion and the maximum number of each item a battalion may have are set forth in an allowance list. When the number of items available in a battalion falls short of the allowance (because of expenditure, wear, casualty, loss, or some other type of attrition), the shortage must be replaced.

Some items, such as range poles, chaining pins, bull-points, turning-point pins, targets, stake bags, equipment boxes, and the like, may be replaced by using the battalion or PWD shops personnel expertise. Most items, however, are replaced from supply; that is, they are ordered from the nearest available naval supply depot.

To replenish an item, you must order by stock number and follow a prescribed procedure. To learn the correct procedures, you should get in touch with one of the supply petty officers in the battalion or study the chapters on the Navy supply system in Military Requirements for Petty Officer Third Class, NAVEDTRA 12044, and *Military Requirements for Petty Officer Second Class,* NAVEDTRA 12045.

NMCB Surveyor's Kit

Every NMCB is properly outfitted with adequate surveying supplies and equipment. These necessary items are listed in the NMCB *Table of Allowance* (TOA) and are contained in Surveyor Kit #80010. For this reason, no attempt will be made to list all the equipment and supplies currently carried in the standard surveyor kit. Normally, four complete kits will be carried in the battalion allowance. They are available for check-out to the surveyor section supervisor or the senior EA. It is the responsibility of each survey party chief to make sure that the kit assigned to the crew is complete. The kits are required to be inventoried during turnover and at twice-monthly intervals throughout deployment. The purpose of these inventories is to ensure 100-percent accountability of the items contained in the kit and to ensure that all of those items are in a proper state of good repair. Remember, if you have custody of the kit, you

can be held financially accountable for items missing or damaged through negligence.

Most consumable items contained in the kit, such as pencils, pencil leads, lumber crayon, and surveyor's flaggings, are stocked in the battalion supply department for kit replenishment. Additional supplies and equipment are also stocked in the engineering office surveyor's linker to supplement the kits.

QUESTIONS

Q1. According to your textbook, the vertical axis is the basis of all adjustments made to the engineer's level. What is the basis for adjustments to the transit?

Q2. You should never attempt to adjust an instrument until the same test, repeated how many times, shows the same amount of error?

Q3. What is the purpose of adjusting the line of sight of a level or a transit?

Q4. Why is it necessary for the vertical cross hair of a transit to be perpendicular to the horizontal axis of the instrument?

Q5. As you have learned when apart, such as a level tube or a cross hair, is out of adjustment, there is a method of compensating for the maladjustment. When should you use these compensating methods?